SCIENCE

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CONTENTS OF VOLUME VII.

SPECIAL ARTICLES.

BOOK REVIEWS.

SCIENCE.

AN ILLUSTRATED JOURNAL PUBLISHED WEEKLY.

Vérité sans peur.

NEW YORK: THE SCIENCE COMPANY.

FRIDAY, JANUARY 1, 1886.

COMMENT AND CRITICISM.

TO MANY PEOPLE in this practical era, the manifest usefulness of work done affords the only available standard of judging every thing. It is worth the while to see how the coast survey abides this test; for it can point to its system of charts covering every harbor of prominence in the country, and nearly all the shore-line between them, all the principal rivers to the head of tidal influence, and Lake Champlain; to its researches and publications relating to terrestrial magnetism, and its magnetic charts; to the tide-tables, published annually, of the ports on the Atlantic, Gulf, and Pacific coasts; to the 'Coast pilots' for the Atlantic and Pacific coasts and Alaska; to its explorations and discoveries in physical hydrography; to its transit-of-Venus and eclipse expeditions, and longitude determinations in Alaska and in foreign countries; to its work on the Isthmus of Panama; to the numerous scientific publications on all subjects relating to or connected with its work; to the determinations of the force of gravity in all parts of the world; to very considerable improvements in geodetic and field-astronomical instruments; and to the present perfected system of weights and measures, which has secured harmony not only within the United States by supplying standard weights and measures to every state, to the principal custom-houses, and to the agricultural colleges in the several states, but also between our own country and foreign nations.

Such an amount of scientific and practical work of the highest merit could not possibly have been accomplished except under the wisest organization and the most efficient supervision. The character of this work is itself the sufficient argument for the maintenance of that organization. With so exceptional a record of work actually accomplished, embracing so much that is of immediate economic bearing upon the welfare of the country and the conservation of national interests, the survey need have little fear of hostile criticism, and, least of all, that having its origin in personal or political motive. The obviously useful character of a large part of this work shows that it is of real and direct value to the nation, apart from its purely scientific merit.

No. 152.—1886.

THERE IS NO PORTION of North America where complete and long-continued series of tidal observations are more important, and will yield more interesting results, than the coast of Canada. The great rise and fall in some portions, and the anomalous conditions and irregular and unequal tidal currents prevailing along its deeply indented shores, render a careful study of them a matter of serious interest from both a scientific and practical point of view. We are glad to see that the matter has been attracting attention among our neighbors, and that the different commercial bodies of Canada have moved in the matter. A report on the subject by a committee of the British association, at the Aberdeen meeting, shows what has been done, and what is proposed. The matter is one more of general than local importance. As such, it appears to be well worthy the attention of the imperial government, which, at small cost to itself, can here properly come to the aid of the colonial department of marine, in the interest of the commerce and navigation of the world. Tidal observations on the eastern coast of America have gained a new importance since the coast and geodetic survey has confirmed by recent observations its announcement, some years since, that there are tidal fluxes in the Gulf Stream, and variations of its velocity due to half-monthly changes in the relative sea-levels of the Atlantic and Gulf of Mexico.

JUDGED BY THE RESULT, it would seem that the civil engineers' convention, recently held at Cleveland, to consider the relations of civil and military engineers, found, that, like an historical gathering at Ephesus, it had come together with-

out sufficient reason. Congress is asked by the convention to 'organize a civil bureau of public works' in a certain way, and for certain reasons. It is difficult for an onlooker to interpret the way and reasons, otherwise than that the army engineers are in possession of a good thing which some of their civil brethren covet: hence the intervention of congress is invoked to change the established order, to put the one class out and the other in, or, if this may not be, that the good thing be at least divided. The reasons given are weak, and open to dispute, some easily refuted; and the request that the basis of organization of the proposed bureau should be studied and reported on by a board consisting of seven members — three military engineers, three civil engineers, and a lawyer — savors quite strongly of place-making for some of the leaders in the movement. All this is unfortunate. There are strong and good reasons why the organization for the conduct of public works should be recast, just as necessity for reorganization has been found in other departments of administration. That these reasons exist is proven by the fact that a letter from the chief of engineers, U. S. army, General Newton, was read at the meeting, expressing sympathy with any move which would better the public service. The betterment of the public service ought to have impressed itself upon the Cleveland meeting as being the only ground upon which they could go before the country with reasonable expectation of being listened to. Instead of this, the convention considered the question as one of class, and seeks to secure class legislation in a way which is itself a suggestion that congress is incapable of doing its own work.

THE COAST AND GEODETIC SURVEY.

THE time was long ago when any one would think of asking what is the use of having any coast survey at all, — one might almost say, long past, when any one would expect that the work of such an organization could ever be brought to an end. As originally constituted, by the act of 1843, the organization was empowered to proceed with the accurate mapping of the Atlantic and Pacific coasts of the United States, — a work which involved a trigonometric survey of the coast-lands to be conducted with the utmost precision. This formed also the only suitable basis for the hydrography of the coasts.

Those interested in the thorough prosecution of this work were not slow to appreciate the obvious advantages of connecting the independent surveys of these coasts into a single homogeneous system. The surveys of individual states might thus be supplied with the precise determination of points for their own topographic and geologic work, and the entire domain of the United States be covered by a net-work of triangles of the utmost accuracy. The foundations of this vast work were laid nearly fifteen years ago; and in its execution natural precedence has been given to those regions where there was the most urgent call for the work. Such a connecting-link is a necessary part of a survey of the 'coasts and adjacent islands, etc., of the United States,' as originally provided for by law, in order to bring into harmony the measurements along the Atlantic and Pacific coasts. As Professor Hilgard has pointed out, this is sufficiently obvious to allow the belief that it would have been specified in the original law, if, at the time of its enactment (1807), the country had had a 'western coast.'

But this is not all: what is the obvious requirement of the law has led, in addition, not only to the incidental accomplishment of important scientific results, but also to many advantages of the most practical significance. To appreciate the former, we need only recall that our national domain extends in an east and west line over about one-eighth of the circumference of the entire earth, and that the accurate measurement of this line, as undertaken by the survey, will constitute much the longest arc-parallel ever measured for determining the size and figure of the earth. The same survey will afford accurate elevations of a multitude of points above a common datum plane, and will show the relation of the mean level of the Atlantic and Pacific oceans. From a purely scientific stand-point, these would be reasons enough for completing the transcontinental survey as originally outlined; but let us see what some of the practical advantages of the work are. To begin with, this already well-advanced scheme of a national survey, from ocean to ocean, provides every subsidiary state survey with an accurate base-line. How important this is will appear if one attempts to conjoin the hitherto existing surveys of adjacent states. Discrepancies of many miles are frequent; for example, "The best maps of the states of Ohio, Indiana, and Kentucky, constructed upon independent data, when put together, leave no delineation of the Ohio River. Between the land-survey maps of Illinois and Missouri, the Mississippi River presents in places wide lakes, while in others it entirely disappears." The transcontinental link also adjusts the lines and points of the public land surveys, and furnishes the necessary data

for the compilation of town, county, and state maps of the utmost precision. Nor is the fact lost sight of that in time it will become necessary to have an absolutely correct map of the entire area of the United States. Work of this character has been for years in progress, and in its continuance rests the only possibility of bringing harmony into what is now utter confusion.

All who have taken even the least cognizance of the scientific methods systematically pursued by the coast survey will experience no difficulty in seeing that the uninterrupted exertions of scores of trained observers and calculators are demanded in completing the thorough survey of so extended a field as that of the Atlantic and Gulf coast. Very few outside of those actually engaged in such work take occasion to know the degree of precision sought and attained in these investigations; nor is it a matter of common information that the work has so far advanced that the survey of the Atlantic and Gulf coast is about nine-tenths completed. The slightest knowledge of the necessary conditions is sufficient to show that, even when the entire extent of the coast has once been charted, a large amount of work must continually be done, in order to maintain the correctness of the charts, and 'Coast pilots' or sailing-directions. Professor Hilgard estimates, that, in order to keep up this work, a force of two parties will be required — one ashore and one afloat — in each of five districts between Passamaquoddy Bay and the Rio Grande.

The entrance of the important harbor of New York is kept under annual examination, in order to keep track of the changes, and to control, if possible, their causes. A complete re-survey of the great thoroughfare of Long Island Sound is in progress, as in time great changes have taken place, and many localities have very much grown in importance. Also thorough re-surveys are progressing in other waters as rapidly as the limited appropriations for this work will allow.

The survey of the Pacific coast, between San Diego (the Mexican boundary) and Fuca Straits, with Puget Sound, is about three-fifths completed; and the publication of charts, sailing-directions, and tide-tables is proportionally advanced. The same considerations in regard to future re-surveys hold here equally with the Atlantic coast: one re-survey of San Francisco Bay was made about twelve years ago, and a new one is now strongly urged. In the territory of Alaska, no minute or exact surveys have yet been undertaken, as the condition of the country does not yet call for them; but a good deal has been done in the way of geographical exploration and hydrographic reconnaissance, while many charts of approximate correctness have been published, as well as a volume of sailing-directions. Mention must be made, in this connection, of the explorations of the Gulf Stream, having for their object the discovery of the laws which govern it, with the view of taking due account of it in navigation as an indication of the approach to our shores; as also of the practical researches into the distribution and laws of change of the earth's magnetism, by which we have been enabled to ascertain the variation of the compass along the coasts, as well as over the whole country, — a knowledge equally important to the mariner and to the land-surveyor.

In no department of its coast operations is the practical usefulness of the survey more apparent than in its systematic researches and publications relating to the safety of navigation. Foremost among these are the thorough series of observations of the tides. In addition to this, advantage is taken in the most practical way of all discoveries and developments affecting the safety of navigation by the printing and wide circulation of the series of 'notices to mariners.' During the year 1883–84, for example, twelve such notices were published as warnings to navigators against newly discovered or newly developed dangers. Also the studies of officers of the survey in the department of physical hydrography have led to results of the highest practical importance in our commerce and navigation.

In his late message to congress, the President of the United States alludes once more to the threadbare subject of transfer of the coast and geodetic survey to the navy department. Three years ago the superintendent of the survey, in a letter to the secretary of the treasury, reviewed the whole ground in the most thorough and impartial manner, concluding with the following points in opposition to this proposed transfer. They may be advantageously cited here: —

"1°. The present system, perfected nearly forty years ago, has proved thoroughly efficient, economical, and satisfactory to the country. It is wise to hold fast to that which has been proved to be good.

"2°. It affords to the navy all the advantages that can legitimately be claimed. It employs as many of its officers in service afloat as can be advantageously used in hydrography. The employment of a larger number, in the event of a transfer, would result in training naval officers to be geodesists, topographers, chiefs of technical bureaus, and in withdrawing their interests and habits from the naval service proper.

"3°. The efficiency of the service would suffer by the loss of ambition and emulation, which exist at present in a high degree, but which find no stimu-

lus in a service where no positions of responsibility and direction are open to civil experts, however great their attainments and devotion to the public service."

Some months subsequently, in a letter to the committee of the National academy of sciences, the superintendent added the important considerations that the naval officers detailed by their department for coast-survey duty are almost without exception well pleased with their service in this capacity, although, in reality, more arduous than the regular routine of the naval service in time of peace. They are at all times, however, perfectly under the control of the navy department, and subject to being detached and ordered upon other duty. No officer of the navy above the rank of commander is attached to the survey, and most of the officers are of the grades between ensign and lieutenant. In this survey work they obtain a most valuable experience, which stands them in great stead on foreign stations.

The alleged duplication of work by the coast survey and the hydrographic office of the navy department is often urged as a reason for the transfer of the survey to the navy; but in reality there is no clashing. The special work of the hydrographic office consists in publishing charts of foreign coasts for the use of the navy and our commercial marine, as also of directing surveys on foreign coasts by our naval vessels when their opportunities permit. The functions of the two offices are thus entirely different.

The hydrographic work conducted by the coast survey along our own shores is not a nautical survey, but, properly speaking, a trigonometrical survey, in which the positions of the depths observed, and of rocks and shoals, are determined by the observation of angles upon objects on shore, which are known by the triangulation and topography. The hydrography is closely co-ordinated with these, and cannot be separated from them without losing much of its present excellence.

DAVID P. TODD.

RECENT CHANGES IN CORNELL UNIVERSITY.

THE growth and prosperity of Cornell university are shown in the measures which its trustees are taking to enlarge and strengthen its faculty. The value of a university lies in its teaching force. Cornell university has been put by its benefactors on a firm financial basis, and the trustees are wisely preparing to employ its increased revenue in adding to its facilities for instruction. The most important of these new measures is the re-organization of the Sibley college of mechanical engineering, with Dr. R. H. Thurston as its director. Following this are the measures just consummated and announced, providing for other changes in the faculty. Dr. Wilson, the distinguished and venerable professor of moral and intellectual philosophy, and Professor Schackford, the professor of rhetoric and general literature, are retired at the end of the present year with liberal allowances. A professorship of pedagogy has been established; and Prof. S. G. Williams, now occupying the chair of geology, is appointed to the new professorship. As this is a new feature in our New York colleges, the results of the experiment are looked to with great interest. Professor Williams has had an unusual training for such a professorship. As a teacher in preparatory schools, as a superintendent of schools, and a professor in Cornell university, he has enjoyed an experience which will enable him to put himself in sympathy with those who are preparing themselves for teaching, and to give them whatever aid is possible.

The retirement of Professor Williams from the chair of geology enables the trustees to consolidate the now separate departments of geology and paleontology in one, and to promote Prof. H. S. Williams, who has occupied the latter chair, to the professorship of geology and paleontology. Other changes are either made or contemplated which will still further re-enforce the board of instruction. Not the least important of these changes is the increase in the salaries paid to all the principal professors. The inadequate compensation heretofore allowed has cost the university in several instances the loss of men whom it would have been glad to retain. Two of the professors are to receive $3,200 each; eleven others, $3,000 each; and in other cases the stipends have been proportionately increased. S.

THE ABBOTT COLLECTION AT THE PEABODY MUSEUM.

THE collection of stone implements made at Trenton, N.J., by Dr. C. C. Abbott, now on exhibition in one of the recently opened rooms of the Peabody museum of archeology at Cambridge, is one of the most important series of the kind ever brought together, and one which archeologists will consult for all time to come. It contains more than twenty thousand stone implements and several hundred associated objects, made of bone, clay, and copper, with several pipes and numerous ornaments and carved stones.

There are several considerations which give the collection exceptional importance. First, it was brought together from a very limited area by a single archeologist; all the specimens having been found by Dr. Abbott upon his own farm and its

immediate vicinity, with the exception of some of the paleolithic implements, and even these were found within an extreme radius of four miles. Second, the gatherings in this limited region have been so long continued and so thorough, that the result is a collection which shows *en masse* the work of the peoples who inhabited the Delaware valley at different periods, in a manner and to an extent never before obtained from any part of this country, and probably not from any other part of the world. Third, the collection is the same which formed the basis of Dr. Abbott's volume on 'Primitive industry,' and has been arranged by Dr. Abbott himself, under the direct supervision of the curator.

As now arranged, the Abbott collection exhibits at one and the same time the sequence of peoples in the valley of the Delaware, from paleolithic man through the intermediate period, to the recent Indians, and the numerical proportion of the many forms of their implements, each in its time. It thus forms an exhibition at once instructive to the general visitor, and of great importance to the serious student. It is indeed doubtful whether any similar collection exists, where a student can gather so much information at sight, as here, where the natural pebbles from the gravel begin the series, and the beautifully chipped points of chert, jasper, and quartz, terminate it in one direction, and the polished celts and grooved stone axes in the other.

The paleolithic implements from the gravel and from the talus include nearly all found, some of them coming from a depth of thirty feet in the gravel; with one exception, a black flint, they are made of a hard, fine-grained argillite; many are but slightly chipped, while others are of well-defined forms, similar to the paleoliths of the old world. With these specimens are the human skull, under jaw, and wisdom-tooth, found at different times in the same gravel as the implements.

Following the paleoliths are the several thousand rude and greatly weathered points and flakes of argillite of various forms. The relative importance of the different sorts to the people who used them is shown in an instructive way by grouping and heaping, so that the eye at once takes cognizance of this, while it detects at the same time the individuality of the makers. These points belong to the middle period of occupation of the valley; never found in the gravel, they are, as a whole, much older than the mere surface specimens and those from graves.

To these latter, the work of the recent Delaware Indians, belong the rude scrapers made by simply splitting a pebble, the rudely chipped agricultural implements of several kinds of stone, and the chipped scrapers, many of which are beautiful illustrations of this kind of work. These, like the arrow-heads, knives, and large spear-like implements shown in an adjoining case, are made from jasper of different colors, as well as from chert and quartz, and are shown in great variety and number. Of the other forms of implements, also illustrated by many varieties of each, are the hammer-stones, rubbing and polishing stones, pitted stones, mortars and pestles, celts and axes.

The ornamental stones are of various shapes, some of them simply perforated; the so-called gorgets are in various stages of manufacture, and there are several carvings representing human heads. A few pipes cut out of stone illustrate the Delaware type of tobacco pipe, while numerous fragments of pottery show that they were also made of clay. The potsherds exhibit a considerable variety of ornamentation, principally by incised lines, though many are cord-marked, and others have impressed designs. Two spear-heads of hammered native copper and a little group of miscellaneous objects are exhibited separately.

Another group of specimens, not included in the enumeration given above, though by no means an unimportant part of the exhibit, are the chips and refuse material of an Indian workshop. This large mass was sifted from the dirt in a single spot a few feet in diameter, evidently from where some Indian long worked in fashioning various implements. In the mass are thousands of chips of stones of various kinds, broken specimens, failures, hammer-stones, and nodules of jasper brought to the place, but still unwrought.

The collection and its arrangement are invaluable, unique, and of extreme importance to all who wish to study the stone age of our Atlantic coast. It reflects great credit upon the industry and sharp-sightedness of the collector, and exhibits as well the same perspicacity and serious method that is a marked feature of the entire museum. The problem of the exhibition of archeological objects, so that they may themselves give the most significant and instructive lessons, without reflecting transitory theories, has found an excellent solution at Cambridge.

FIRST LESSONS IN PHILOSOPHY.

PROFESSOR DE MORGAN, in his wonderfully witty 'Budget of paradoxes,' speaking of the dislike of most people to discriminate beyond a certain point, says, that, for the majority, "all such things as distinctions are evasions, subterfuges, come-offs, loop-holes, etc. They would hang a

First lessons in philosophy, being an introduction to metaphysic and logic for beginners. By M. S. HANDLEY. New York, *Scribner & Welford*, 1883. 16°.

man for horse-stealing under a statute for sheep-stealing, and would laugh at you if you quibbled about the distinction between a horse and a sheep." This certainly is most solemnly true, and is, among other things, the reason why people, as a rule, care so little for philosophy, the vital air of which is the persistent making of distinctions long after the saturation-point of the average human intellect has been reached. We all have our philosophies, to be sure, such as they are; but we all refuse to discuss them in the light of distinctions finer than our own. Such distinctions are 'cobwebs,' 'hair-splittings,' and the like; and we blankly ignore them with a perfectly good conscience. This is why no amount of criticism, however truly able, will shake the hold which certain popular philosophies have on 'the gallery;' for there is a gallery in philosophy, as in livelier spectacles. Mr. Shadworth Hodgson is certainly, of all English-writing philosophers, the one who makes the largest and most incessant demands on his reader's ability to take a distinction. He distinguishes after most of us long for rest, and he probably seems, in consequence, to the majority of those who open his pages, over-subtle and unreal, in spite of the extraordinary originality and vigor of every thing he writes. Many, to our knowledge, have wished that some disciple would come and issue his thoughts in the shape of small change, since they seem so little likely to become popular in the master's own massive statements. Miss Handley has essayed this useful task in the thin volume before us, which we recommend to all who would like a glimpse into some of the main features of Hodgson's system, but by no means to those to whom the title 'First lessons in philosophy' suggests a text-book for high-school use. The work is gracefully written in dialogue-form; but the contents are too technical to be touched upon in our space. We must confess, that, after one reading, we are still in some doubt as to whether Miss Handley's pages have brought Mr. Hodgson within range of those for whom his own are too abstruse.

NOTES AND NEWS.

A TELEGRAM from Dr. Swift, dated Dec. 27, announces the discovery of a comparatively bright telescopic comet, by Mr. W. R. Brooks, at Phelps, N.Y., an easterly motion being 'strongly suspected.' The discovery is confirmed by an observation at Harvard on Dec. 28. The comet is circular, about 3′ in diameter, equivalent in brightness to a star of the ninth magnitude, and it has a strong, eccentrically placed condensation, but no tail. The position given by Professor Pickering for Dec. 28.4684, Greenwich mean time, is, R. A. $19^h\ 59^m\ 27^s$; Dec. $+ 4°\ 31'\ 34''$; so that the comet would now set, in this latitude, about three hours after the sun.

— 'Short studies from nature' (New York, *Cassell*, 1885) is one of many books intended to interest general readers in the later scientific discoveries. Six of the ten chapters treat of zoölogical subjects, bats, dragon-flies, oak-apples, birds of passage, glow-worms, and Foraminifera. They are generally well written, and contain much that is interesting in a readable form. They treat mainly or entirely of English animals; but in most cases the notes and description would apply equally well, with a change of specific name, to our American representatives, and be equally interesting to our American readers. There are also chemical and astronomical chapters, and one on caves.

— Any book which will draw the attention of young or old to the habits of common animals deserves all encouragement. We have a few such already; but any one who has examined other books of this class will find, on comparison, that Holder's work ('Marvels of animal life,' *Scribner*, 1885), while compact, has a wider scope, and contains a large amount of fresh material. Very many of the animals described are not members of our fauna; but there are enough familiar forms described to encourage us to study the habits of more of our common animals, and to hint of the possibility of interesting discoveries awaiting patient observers. The fact that the writer has been an eye-witness of most which he describes, makes his work entirely different from the mere compilations of which most similar books are composed, and makes one almost forget while reading that he is not himself an eye-witness. The writer's style is fresh and attractive. It will surprise some readers to see man and the Pteranodon represented on plate xxxi. as contemporaneous. Possibly, however, the supposed human figure may not be that of a man: it might easily be almost any thing else. The plates, unfortunately, never accompany the description, but are the reward of patient search.

— The prize of 500 francs left by M. A. P. de Candolle is offered by the Société physique et d'histoire naturelle, of Geneva, for the best unpublished monograph on a class or family of plants; the essays written in any of the four great European languages or Latin, to be sent in on Oct. 1, 1889.

— A catalogue of the printed maps, plans, and charts in the British museum has been prepared by Professor Douglas, and will be issued in two large volumes.

— An Italian ship has been sheathed with glass plates, cast like iron plates, so as to fit the hull, to take the place of copper sheathings. The joints of the plates are made water-tight by the use of waterproof mastic. The advantages claimed for glass over copper are its insensibility to oxidation and its exemption from incrustation.

WASHINGTON LETTER.

AT the last meeting of the Philosophical society the evening was devoted entirely to the election of officers for the ensuing year, and the reception of the annual reports of the secretaries and treasurer. The report of the secretaries included some comparisons of the work of the society in 1885 with that of 1884, a *résumé* of which will doubtless be of interest to many readers of *Science* who are connected with scientific societies in other parts of the country.

The number of new members admitted in 1885 was 20, while in the previous year 35 were added to the roll. The total active membership has increased from 173 in 1884, to 183 at the close of 1885. Sixteen meetings were held in 1885, one more than in the previous year. The average attendance at these meetings has increased from 42 in 1884, to 48 in 1885, showing a considerably greater percentage of increase than that in the active membership. The number of papers presented was the same in both years, being 32; while the number of persons taking part in the discussions increased from 38 to 41. The 'general committee,' which transacts most of the business of the society, consists of 17 members. The average attendance at the meetings of this committee was 11.9 in 1884, and 12.1 in 1885.

To this exhibit ought to be added that of the mathematical section of the society, which held six meetings in 1885 with an average attendance of 15, these numbers being identical with those for the previous year. The section received 11 papers in 1884, and 14 in 1885.

Altogether the showing is indicative of steady progress. In round numbers, it may be said to enroll two hundred active members, and at any of its meetings one is tolerably certain to find as many as fifty people.

The report of the treasurer was also satisfactory, showing the financial condition of the society to be excellent. It must not be forgotten that within a few years three vigorous societies have 'swarmed' from this, including the anthropological, biological, and chemical societies of Washington, and that one or two of them are larger than the parent society. By careful attention to the character of the papers presented, the committee on communications has prevented specialization, and has thus succeeded in retaining the support and loyalty of those interested in all departments of science. The philosophical society is not yet fifteen years old, but it promises to be one of the three or four leading scientific societies in the country.

The joint committee of congress for the consideration of the scientific bureaus of the government continued its work up to the holiday recess. It is said that the geological survey was recently the subject of a searching investigation at its hands, the examination having to do principally with business methods and financial transactions. As stated in a previous letter, the recent addresses of the retiring presidents of some of the societies were devoted, in some degree, to the consideration of the absorbing question of the relation of the government to scientific work; and it is known that at least one member of the joint committee availed himself of the opportunity then afforded to learn something of the views of representative scientific men, expressed with that freedom from restraint which is characteristic of communications of that nature. The committee is expected to report in January.

The 'star-eyed goddess of reform,' as represented by the auditors of the treasury department, very properly shows herself to be blind to the existence of party lines or political affiliations. Commissioner Coleman of the agricultural bureau has recently had an account suspended against him, amounting to $1,800, arising out of the purchase of seeds for distribution by members of congress among their constituents. The purchase was made very soon after his appointment, and appears to be precisely similar in character to those which gave rise to the much larger discrepancy in the accounts of his predecessor, Commissioner Loring. It will not be regretted if the adjustment of these accounts leads to a revolution in the manner of conducting the seed-business in the department, which has for many years diverted a large part of the annual appropriation from channels in which it might have been made tributary to the real progress of agriculture.

The friends of Dr. Emil Bessels will regret to learn of the loss he has sustained in the burning of his residence in Prince George county, Md., not far from Washington. The fire occurred on Christmas morning, and it is stated that the doctor himself had a narrow escape. The principal and irreparable loss was his library, which is said to have been entirely destroyed. It included a large collection of rare and costly scientific books, valuable manuscripts, and arctic charts. Z.

Washington, D.C., Dec. 28.

LETTERS TO THE EDITOR.

**** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The temperature of the moon.

THE interesting article by Mr. Ferrel in your issue of Dec. 18 seems to require some words of comment for the general reader, who may not otherwise notice that the whole reflected heat (and light) of the moon appears to be there omitted from consideration. Moonlight is the ocular evidence that a part, at least, of the moon's heat is lost by reflection, since what is light to the eye is heat to the thermoscope. In fact, what we see is but about one-third of what is reflected; and all of this must be subtracted from what the sun sends the moon before we have as a remainder the amount radiated from its surface, which is treated as the whole sum in the article under discussion.

It is there assumed that the moon loses heat by radiation only; but, even in this hypothesis, the highest temperature assigned to its sunlit surface is but little above that of boiling water. Since, then, bodies only begin to be visible by radiation at a red heat, it follows from this hypothesis that the full moon would always be black and invisible, — an imaginary moon, and not the moon which we see. Mr. Ferrel is doubtless aware of this, and in his own view may be supposed to be purely treating of a hypothetical body; but the ordinary reader is certainly apt not to understand the strictly limited premises with which he starts.

In the exactness and competence of Mr. Ferrel's mathematical treatment of this or any subject he presents, all will agree; but the more exact the logical instrument, the more certain it is to deduce limited conclusions from limited premises.

Without entering on any discussion of Mr. Ferrel's use of Dulong and Petit's formula, I may then say that to those astronomers and physicists who are engaged in the task of experimentally determining the actual temperature of the lunar surface, the existence of this great amount of reflected heat is an enormous difficulty, for it is not until this has been differentiated from the radiated heat that the temperature of the actual surface is either theoretically or experimentally ascertainable.

To the present Earl of Rosse belongs the credit of making the first attempt to do this, and, in doing so, to conquer those experimental difficulties which lie even at the threshold, and which alone are excessive; for the total amount of all the heat of both kinds is so minute as not to change the reading of a thermometer directly exposed to the rays of the full moon by nearly so much as the thousandth part of a centigrade degree.

The writer has now been engaged for a long time in these researches, whose interest and importance to us are not to be measured by the minute amount of the heat in question.

To prevent mistake, let it be stated that there never has at any time been any doubt but that the lunar surface radiates heat toward us, and there is scarcely a doubt but that this radiated heat is greater than the reflected. The question is, however, as to the amounts, and as to whether the first kind passes through our atmosphere as well as the second.

This is not the place to discuss this somewhat recondite point; but the as yet unpublished Allegheny observations, now conducted through over twenty lunations with the object of discriminating the reflected from the radiated heat by the formation of a lunar heat-spectrum, show that a considerable part of this radiated heat does pass through our atmosphere along with that reflected. While the writer differs from the conclusions of Lord Rosse as to the temperature of the lunar surface, it seems due to truth to say, that, in the particular just alluded to, the interpretation of Lord Rosse is sustained more fully than his own first one.

Without anticipating the publication of these experiments, the reader may care to learn of one observation made on the rare occasion when the full moon is partially dark; that is, during an eclipse. In the lunar eclipse of Sept. 23, 1885, about eight-tenths of the moon's diameter was covered by the umbra. The night was beautifully clear at Allegheny, and observations were made with the bolometer on different parts of the lunar image formed by a concave mirror of twelve inches aperture, and ten feet three inches in focal length, which was kindly loaned for the occasion by Mr. J. A. Brashear. The image was a little over an inch in diameter, and the bolometer was limited by a diaphragm to an aperture of about three-tenths of an inch; so that any circular portion of the moon's surface forming about one-eleventh of the whole could be examined independently of the rest. Previous observers have been obliged to utilize all the lunar rays from a large concave mirror in forming a very small image barely covering the thermopile employed; but, owing to the superior delicacy of the bolometer, it has thus become possible to select small portions of a comparatively large lunar image for separate study, and still have heat enough for accurate measurement.

Before the eclipse began, the exposure of the bolometer to the central portion of the image produced a galvanometer deflection of one hundred and eighty divisions. The deflection on the east limb of the moon was one hundred and sixty-four divisions; but, as the eclipse advanced, the deflections here fell off very rapidly, the diminution being noticed before the penumbral shade became certainly visible to the eye. The diminution of the effect on the centre and west limb followed that on the east limb in time, as these regions were progressively covered by the shadow. On portions covered by the umbra the deflection was very small, varying from four divisions soon after the beginning of immersion, to scarcely more than a single division of the galvanometer scale shortly before emersion from the umbra; so that the deflection was with difficulty detected. This last minute effect might have been due to true radiation from the darkened lunar surface, or possibly to diffuse and irregularly reflected heat from the surface of the mirror, though the method of exposure was calculated to eliminate this source of error as far as possible, — a doubt which must be resolved by future experiment.

As the middle of the eclipse approached, measures made just outside the edge of the umbra indicated an increasing transmissibility by glass for the feeble radiant energy remaining. Thirty minutes before the middle of the eclipse, the transmission by glass for the lunar heat rays at this inner edge of the penumbra was found to be thirty-two per cent, and fifty-five minutes later it had increased to forty-eight per cent. Although these latter deflections were very small, the observations were apparently trust-

worthy. The average transmission of the lunar rays by glass during the eclipse was about twenty-two per cent, and did not differ very materially from that for the uneclipsed moon on this day. If the increased transmissibility at the outer edge of the umbra be a real effect, it is possibly local and evanescent.

The deflection obtained from a portion of the lunar surface just in advance of the umbra did not very materially differ from that given by a similar portion over which the umbra had just passed.

Clouds, preventing further observations, began to form as the penumbra was about passing off. There were indications, however, of a recovery of heat nearly as rapid as the previous fall. This effect was shown, though in a less marked manner, by Dr. Boeddicker's observations, in the eclipse of Oct. 4, 1884, made at Lord Rosse's observatory (see *Nature*, xxx. p. 589).

The following are the deflections observed on each point during the progress of the eclipse at Allegheny:

	Deflection.	Time.	Time from mid-eclipse.		Deflection.	Time.	Time from mid-eclipse.		Deflection.	Time.	Time from mid-eclipse
		h. m.	h. m.	Centre.		h. m.	h. m.	West		h. m.	h. m.
East	164	11.53	2.35		180	12.01	2.27		155	12.16	2 12
"	125	12.26	2.28	"	128	12.44	1.44	"	153	12.32	1.56
"	45	12.53	1.35	"	101	1.06	1.22	"	129	12.58	1.30
N.E.	4	1.28	1.00	"	31	3.49	1.21	"	21	4.05	1.37
S.E.	71	3.43	1.15								

The salient feature of these observations is, we need hardly say, the extraordinary rapidity with which the lunar surface parts with its heat, most of that which is radiated disappearing all but simultaneously with that reflected. S. P. LANGLEY.

Allegheny observatory, Dec. 23.

Sir William Thomson to the coefficients.

I know of no easier way to reach those for whom the enclosed message was especially intended than through the columns of *Science*. At the same time, I believe it will be read with great interest by many who were not of the somewhat limited number referred to. To such, a brief explanation may be due: —

At the close of the course of lectures by Sir William Thomson, at Baltimore, in October, 1884, it was determined by those who, through the courtesy of the Johns Hopkins university, had enjoyed the privilege of listening to the course, to present Sir William with a memento of the occasion which had been, to them, of such unusual interest. Under the circumstances, nothing could have been more fitting for this purpose than one of Professor Rowland's large concave gratings, which was accordingly agreed upon. Several months were required for the manufacture and examination of a grating which was entirely satisfactory to Professor Rowland; but early in the past summer it was completed, and transmitted to Sir William Thomson through the kindness of the secretary of the Smithsonian institution.

Prof. George Forbes of London was present during the course of lectures, and Lord Rayleigh attended a number of them. In the equations of motion developed in the work there appeared twenty-one coefficients, agreeing in number nearly, if not exactly, with the number of persons in regular attendance upon the lectures. This relation was quickly noticed by some one, and was made the basis of some humorous verses composed by the genial and witty Forbes, which were read at a reception given to the class by President Gilman, and were afterward published. Their title was "The lament of the twenty-one coefficients in parting from each other and from their much-esteemed molecule."

The first stanza began, —

"An aeolotropic molecule was looking at the view.
Surrounded by his coefficients, twenty one or two;"

and the whole will always possess much interest to those who were present. With this explanation, I justify the title which I have given to the following selections from a letter recently received from Sir William Thomson. T. C. M.

Washington, D.C., Dec. 28.

I wrote to Professor Rowland, acknowledging the receipt of the grating; but I ought before now to have thanked all the other coefficients for their kindness in giving it to me. I should feel greatly obliged if you would transmit to those of the coefficients who are in America my heartiest thanks for their great kindness, and say to them that the grating will be a permanent memorial to me of the happy three weeks of 1884, when we were together in Baltimore. . . . After the British association meeting at Aberdeen, I was delighted to be able to show the grating to some of our English appreciators, — including one of the coefficients, George Forbes; and Lord Rayleigh, whom we may consider as, at all events, a partial coefficient; and Professor Fitzgerald of Trinity college, Dublin; Oliver Lodge of Liverpool; Glazebrooke of Cambridge; and Captain Creak of the compass department of our admiralty, — who came to stay with us at Netherhall, our country house, for a few days, on their way south. We had no sunlight to work with, but we got the double sodium light in the first and second spectrums from a salted spirit-lamp flame exceedingly well, and we were all delighted with the result. I had never myself seen any thing like it before. WILLIAM THOMSON.

The university, Glasgow, Dec. 5.

A waste of public money.

My attention has just been drawn to your notice in *Science* of Dec. 4, of my forthcoming report on irrigation. The substance of your criticism is that quantity, and not quality, appears to have been the object in its compilation, — that the work should have been written in one volume instead of three; and you quote a long, redundant paragraph as a sample of the composition throughout.

It is to be regretted that you undertook to criticise an entire report, when you had before you only some advance sheets of one volume, very hastily printed from unrevised manuscript, solely for the purpose of an exhibit to the legislature, which desired to know something of the scope of the work.

The entire report, as ordered printed, is now under way; and I believe you will find, when you receive a copy, a decided improvement in the literary construction which you have criticised. As for the general make-up of the work, — its fulness, and occasional repetition of matter under different headings, — which you do not specially refer to, but probably have noticed, I shall have something to say at the

proper time and place. In the mean while, the many kindly, encouraging, and sometimes flattering words of approval which I have received from persons who have read the 'advance sheets' you criticise, and whom I believe to be specially qualified to judge of a work on this subject, will sustain me in the labor of completing it as begun.

You have criticised a work projected on one plan, and to fill a demand amongst irrigators and persons, from one cause or another, interested in the details of the subject, as though it purported to be on another plan, and for general circulation and sale. When the first volume is published, I hope to make this clear to you. It has always been the intention to bring the more important matter of general interest in this report within the compass of one moderately sized volume, to meet the demand of which you speak. This was the subject of a recommendation to the legislature, in my biennial report transmitted with the advance sheets of the final report; and I am glad to tell you that there will be submitted to the legislature at its next session (January, 1887) a concise and readable report for general circulation, in addition to the more voluminous books of reference.

WM. HAM. HALL,
State engineer, California.

Sacramento, Cal., Dec. 22.

The Davenport tablet.

As the evidence in regard to the limestone tablet indicates that it was a plant made to deceive the members of the Davenport academy, we are led to inquire whether the authenticity of the shale tablets rests on any better foundation. Accepting the statements in regard to their discovery as published in the Proceedings, and referring to the excellent albertypes on plates 1, 2, and 3, vol. ii., we notice the following facts calculated to arouse suspicion: —

On the so-called 'cremation scene,' plate 1, vol. ii., are three Arabic 8's, one so much like that on the limestone tablet as almost to lead to the belief that the two were made by one hand. Moreover, there are, as admitted by the finder (vol. ii. p. 223), four other characters on the latter identical with characters in the 'cremation scene.' This links the two so closely together as to induce the belief that they belong in the same category, and hence that the conclusion reached in regard to the limestone tablet must apply to all the shale tablets, as the latter were found together in the mound known as No. 3 of the 'Cook farm group.' It is also stated in the Proceedings (vol. ii. p. 223), that the bird-figures on the limestone tablet "have each a bit of quartz crystal set in for an eye, *like the eyes of the animal figure from mound No.* 3, . . . and, like those, they are held in place by a white cement of some kind." This animal figure was found in the dirt thrown out of mound No. 3, from which the shale tablets were obtained (vol. ii. p. 256). It is therefore almost impossible to avoid the conclusion that all must stand or fall together.

No. 3 appears to have been a double mound, the southern portion only having been explored in 1874; the northern part (in which the shale tablets were found), not until 1877. According to Dr. Farquharson (vol. i. p. 119), the part first opened contained no layers of shells or stones; and no mention is made of an excavation or grave in the earth beneath, nor does the figure (No. 3, plate 2, vol. i.) show any stratification or grave. Turning to the figure of the same mound (vol. ii. p. 92), we find both strata and grave represented in this southern portion. Mr. Gass, in his subsequent account (vol. ii. p. 92), says some errors were made in the first description and illustrations; but Dr. Farquharson says his description was made from Mr. Gass's statements, and partly from personal observation on the spot (vol. i. p. 118). Attention is also called to the fact that the skeletons of the intrusive burial over the southern grave, as well as the three in it, were whole and undisturbed; while over the northern grave the human bones of the intrusive burial were scattered through the soil, and with them the fragments of a brass ring; while in it, beneath the shell stratum, were "fragments of human bones and small pieces of coal slate or bituminous shale" (Mr. Gass's account, Proceedings, vol. ii. pp. 95, 96). In the plan of the mound (fig. 9, vol. ii. p. 93), a single skull is represented in this northern grave where the tablets were discovered. This condition of the contents is scarcely consistent with the idea that there had been no previous disturbance of this part of the mound.

The tablets were not discovered until five o'clock in the afternoon (Jan. 10), "*covered on both sides with clay, on removal of which the markings were for the first time discovered*" (vol. ii. p. 96), yet we are informed which side of each was upward as they lay in their resting-place.

It may not be out of place to call attention to the fact that nearly all of the letter characters of the 'cremation scene,' as represented on the albertype, may be found on p. 1766 of Webster's unabridged dictionary, edition of 1872, or any subsequent edition, where the letters of the ancient alphabets of the old world are figured. A few, it is true, are reversed, and in some instances the form is slightly varied; but the resemblance in most cases is very strong. The reader can make the comparison for himself; but I would call his attention to the fact that in the upper of the two transverse curved lines, near the right-hand end, the two forms of the 'Gallic' *O appear together*, just as given on the page of the dictionary. He will also observe that in some instances a number of characters in close relation on the tablet are found near together on the page of the dictionary; here, also, we find the 8 so often used on the tablets. A photograph or the albertype must be used for this comparison.

It is true, letters of almost any form can be found on this page, but it would be an anomaly to find a brief ancient inscription consisting of letters from half a dozen alphabets of widely different ages, and partly of the angular and partly of the cursive types. That this is true of this inscription, is readily seen by the suggested comparison. Dr. Seyfforth, in his attempt at an explanation, published in vol. iii. of the Proceedings, was forced to go to half a dozen or more alphabets to find the letters given in this single short inscription.

The tablet represented in plate 3, vol. ii., and known as the 'calendar stone,' indicates, beyond any reasonable doubt, contact with people acquainted with the twelve signs of the zodiac. This is admitted by Dr. Farquharson (vol. ii. p. 109) and Dr. Seyfforth (vol. iii. p. 77), and necessarily forces us to the conclusion that it is post-Columbian, or the result of contact, possibly at some very ancient date, with people of the eastern hemisphere.

The fact that the diameter of the inner circle is

exactly two inches, of the next three and a half inches, and next to the outer one five inches, 'certainly has a modern look,' as Dr. Farquharson truly remarks (vol. ii. p. 109). The reader is doubtless aware that among the illustrations in the latter part of the dictionary mentioned is a figure of the zodiac with four rings or zones (p. 1704).

These facts, gathered from the statements and figures published in the Proceedings of the academy, are presented for consideration by our antiquarians. The question of the authenticity of these relics should, if possible, be definitely settled, as they have, if genuine, an important bearing on some troublesome archeological problems. CYRUS THOMAS.

Dr. Otto Meyer and the south-western tertiary.

In the December number of the *American journal of science*, Dr. Otto Meyer publishes what purports to be a reply to criticisms on his attempt to prove that all observers previous to himself have been mistaken as to the broad facts of the succession of the tertiary strata of the south-western states, and that what Lyell and the American geologists have found to be the top is really the bottom, and *vice versa*. This is the third of three lengthy papers devoted by him to the same theme; and one would naturally suppose that one who is allowed to occupy so much space in a scientific journal of such high standing had at least some new observations of his own to communicate, upon which to base so sweeping an assertion; and that he had studied and candidly considered the published work of his predecessors. His second paper showed the extremely limited extent of his own observations, and his failure to even read, much less study, the literature of the subject, from which he quoted only disjointed sentences, selected to suit his ideas. The three articles in the October number of the journal, from three observers whose observations he calmly sets aside as unworthy of confidence beside his own superior lights, expressed their astonishment at the cool assumption, grounded on such a slender basis, that pervades Dr. Meyer's methods and assertions; and they gave a few of the simple facts that irrefragably prove the correctness of the recognized succession of formations.

In his latest article, Meyer goes even farther than before. He not only denies categorically that stratigraphy alone, including dips, can give any certainty as to the natural succession of the formations, unless we could 'follow the strata foot by foot;' but he proceeds to pick out from the work of myself and others such portions as leave room for doubt in their interpretation, and upon these constructs and supports his fanciful fabric. He simply ignores facts pointedly stated, that completely overturn his whole scheme; as, for instance, the paragraph in which I state the fact, verified innumerable times, that the sandstone of the Grand Gulf group is found "*overlying* the Vicksburg strata generally along the southern line of the Vicksburg group." In the face of this statement, which, if he had chosen, he could easily have verified near the very localities examined hy him at Jackson and Vicksburg, and of the universal and patent fact that all the divisions of the Mississippi tertiary disappear beneath the drainage-level with a southward or south-westward dip, he presents for acceptance by guileless American geologists a section in which the Grand Gulf rocks are made the base of the tertiary. In referring to the re-appearance of the Jackson shell bed at one point on the Chickasawha River, southward of the main belt, he entirely overlooks the fact that it is there directly overlaid by the most characteristic 'orbitoides limestone' of the Vicksburg group, under which it disappears to southward.

Similar methods are pursued in other cases, varied with elementary platitudes concerning the general value of lithological and paleontological characters.

I cannot consent to cumber the columns of this or any other journal with a detailed refutation of assertions founded upon such methods of procedure. Whenever Dr. Meyer or any one else shall come forward with any thing tangible that seems incompatible with the results deduced from my elaborate researches in the south-western tertiary, I am ready to discuss the issue; but I am unwilling to waste time, paper, and ink upon the flimsy but elastic structure which Dr. Meyer has, in the face of known facts, evolved from his inner consciousness. Fortunately, the geological area which he attempts to turn wrong side up is now again under examination by competent observers, who have no hobby to ride, and whose results, I have reason to hope, will be made public before many months. In the mean time, I commend Dr. Meyer's methods to the attention of ambitious young geologists as a conspicuous example of 'how not to do it.' E. W. HILGARD.

Berkeley, Cal., Dec. 15.

A new meteoric iron from West Virginia.

In your last issue appears a communication entitled 'A new meteoric iron from West Virginia,' in which a meteorite said to have been found near Charleston, Kanawha county, W.Va., is described.

The writer is evidently not aware that this same piece of iron was described in a paper read at the meeting of the American association for the advancement of science, held at Ann Arbor in August last. The transactions of that session are not yet published, but the title of the paper above mentioned was noticed in *Science*, vi. No. 136, p. 222, Sept. 11, and in the *American journal of science*, xxx. No. 178, p. 326, October, 1885. No mention would be made of this oversight if the iron were correctly described, but several inaccuracies demand attention. When the paper was prepared, the only information at my command was that furnished me by Dr. H. G. Torrey, and was simply this: that the iron had been sent to him from Charleston, Kanawha county, W.Va., by Major Delafield Du Bois, who wished to have it assayed. The major had received it from parties who thought it precious metal of some kind.

Since this first report was made, Major Du Bois has looked up the matter more thoroughly, visiting the true locality, and making many inquiries. At a meeting of the New York academy of sciences, Nov. 30, the writer read a paper, announcing the full particulars of the finding. Owing to press of matter, this paper will not appear in the *American journal of science* until February, and in the New York academy proceedings as customarily published. I then announced the true locality to be Jenny's Creek, — a fork of the Big Sandy River, 15 miles from the Chatteroy railroad, 35 miles from Louisa, Kentucky, and 38 miles from Wayne Court-house, Wayne county, W.Va., not Kanawha county, as formerly announced. Your correspondent says, "Of its chemical constitution and the circumstances of its fall, we are quite ignorant." He further asserts that

the iron was devoid of any thing like a crust. I would repeat that the iron was found in October, 1883, in two masses aggregating at least twenty-five pounds in weight, and that both these masses were covered with a crust. I presented an analysis of the iron made by Mr. James B. Mackintosh of the School of mines, New York, and also cuts showing two views of the iron, and one of the crystalline structure of its surfaces. The iron which I described is unquestionably that mentioned by the writer in your last issue.

Instead of being found near Greenbrier county, it was found two counties farther off, or one hundred miles. Hence it is scarcely credible that all these pieces are fragments of a meteorite which burst in mid-air.

It is exceedingly important in the study of meteorites that wrong localities should not creep into print. If this instance were allowed to pass unnoticed, it would result in the recording of two distinct falls; i.e., one at Charleston, Kanawha county, W.Va., and the other at Jenny's Creek, Wayne county, W.Va. The two small pieces brought to me from Wayne county are identical with the original piece loaned to me for description, and the danger of meeting with these remaining fragments as supposed new finds was touched upon in the paper read at the Academy of sciences. GEORGE F. KUNZ.

A national university.

In No. 149 of *Science* (Dec. 11), in an article on 'A national university,' is a criticism upon that part of the report of Secretary Lamar recommending the establishment of a national university in Washington. The writer urges that there must be "a fatal defect in any congressional bill to establish a university, so long as the principles of appointment to United States offices, and the tenure of those offices, remain what they are." The writer is ignorant of the fact that we now have established in Washington, by congressional bill, the Columbia institution for the deaf and dumb and the Howard university. Both of these institutions, in their present form, were established by congress, and are supported by yearly appropriations. No greater degree of permanence in tenure of office is found in any university of the country than in these, and no difficulty is experienced in finding competent and able professors and instructors.

The next objection is, that "the government of a national university would necessarily be in the hands of some board of officers, and the constitution of such a board would lead to many difficulties."

We supposed that all universities were in the control of some board, and in almost every one of our large universities the constitution of such a board has led to many difficulties: the board of Yale college is now no exception. The Smithsonian institution is controlled by a board of officers appointed by congress, and it has not led to the difficulties suggested. The influence of sectional feeling has not been felt, and we doubt if any plan could have been devised by which more good could have been accomplished than has been by the board of the Smithsonian, with Professors Henry and Baird as its secretaries.

The writer objects that "the gift of such an education would rest in the hands of the members of congress, and would only place so much injurious patronage at their disposal."

There would be no necessity for any thing of this kind. Such patronage does not exist either in the Columbia institution or the Howard university; but, even if it should rest in the members of congress, the results in analogous cases prove that the objection has no weight. The appointments both to West Point and the Naval school at Annapolis are in the gift of the members of congress, and there are no institutions of the kind in the world where abler men or better scholars have been graduated. These institutions have educated and trained commanders of the army and navy, and they have in war and in peace shown the excellence of their education.

The last objection is, that a national university would be un-American in principles. Washington, Jefferson, Madison, and Adams thought a national university was necessary. We do not understand how an institution which the founders of our country recommended can be considered un-American.

There is no place in the country which possesses such advantages for a national university as Washington. Here are the Smithsonian institution with its various departments, the geological survey, the coast survey, the nautical almanac, the hydrographic office, the signal-service bureau, the national museum, the medical museum, the patent office, the libraries in the various departments, and the congressional library, — each of these bureaus presided over by gentlemen of the highest ability, aided by a corps of men the equals of those of any of our universities; the whole forming a nucleus for a university, when grouped together and combined, superior to any in the world. Washington is the capital of the country, and is to-day a centre of more scientific apparatus and more scientific men than any other city in the union. G. G. H.

It is perhaps unnecessary to point out the difference between a 'national university' and a university incorporated by act of congress.

I think the writer of the above letter must be unaware that the absolute permanence of tenure of office during efficiency is the one great inducement which leads young men of good parts to enter the service of such a college as Harvard. It goes without saying, that it would be out of the question to induce one of the full professors at Harvard, except for much larger pay, to give up his reasonable salary, his position for life, and his comparative freedom from the necessity of explaining his work to unsympathetic critics, to accept a position under the United States government, where he could, by constitutional provision, only be sure of his salary and place from year to year; whereas I know of the anxiety felt by instructors in colleges under city control to escape from their bondage to the politician.

It is true that there are a large number of scientific men in government employ, but they are there for the simple reason that there is the one great market for their services. It has never been my fortune to meet with any teacher who would not prefer to be in the employ of a private school or college, rather than in that of city, state, or United States. The constant parleying with politicians which government employ entails is simply unbearable for many of the men, whose disposition leads them to choose the teacher's life.

The scientific bureaus were established by the United States with the view of making surveys of the country, and the work of scientific investigation is carried on at present only with the object of mak-

ing such surveys possible. It is a step in a radically new direction to introduce the prosecution of investigation *per se;* and it should be well considered where this begins, and whether it is the proper function of the government to prosecute such work. The establishment of a teaching university is a still greater step.

There is further, in my opinion, no need of a university in Washington, as we already have as good an institution as could be wished at the neighboring city of Baltimore.

An appeal to the prestige of the names of the statesmen of the early days of the country is always to be deprecated. We are suffering at the present time from a law passed under the hurrah raised by a similar appeal. L. S.

Some points in the evolution of the horses.

The main facts with regard to the evolution of the horses have long been known, and the series of modifications in the limbs, skull, and molar teeth, so fully described, that little doubt remains as to the various links in the long chain. But, in tracing out the line of descent of any group of organisms, it is not only necessary to follow out the steps of progression in a general way, but in all their details. In the case of fossils, this must, for the most part, be done by many different observers, as so much depends upon the fortunate discovery of good specimens. The present note gives a small contribution of this kind to the elucidation of the history of the horses.

The earliest member of the series of which we know much is the Hyracotherium of Owen (Orohippus, Marsh). This little animal is quite abundant in the lower eocene of Wyoming, and has been very fully described by Professor Cope. In this genus (fig. 1) the incisors are arranged in a semicircle,

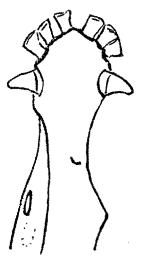


FIG. 1. — Lower incisor and canine series of Hyracotherium (after Cope). One-half natural size.

FIG. 2. — Lower incisor and canine series of Anchitherium (after Kowalewsky).

either uninterruptedly or separated by slight intervals. They are simple teeth, with sharp, chisel-shaped crowns. The canines are small, conical, and everted. The symphysis of the lower jaw is long and much contracted, rounded and somewhat expanded at the end.

The next type in the series is the Mesohippus of Professor Marsh, from the White River beds or lower miocene. Although the characters which Professor Marsh gives as separating this form from Anchitherium are either inaccurate or not of generic value, Mesohippus must, as we shall presently see, be regarded as a distinct genus. Here the shape of the mandibular symphysis and of the incisor teeth is very much as in Hyracotherium. The incisors are small, with rather broad, chisel-shaped crowns, and without a trace of an invagination of the enamel. The advance from Hyracotherium to Mesohippus consists chiefly in the increased size of the animal, reduction of the number of digits, greater complexity of the premolar and molar teeth, and enlargement of the brain. Specimens of Mesohippus with the incisors in position are rather rare. The description given above is of a small species (No. 10,246 of the Princeton museum) which was obtained by the Princeton scientific expedition of 1878 at Chalk Bluffs, Colorado.

In the upper miocene deposits of the Pacific coast the true Anchitherium (Miohippus, Marsh) appears. In this genus the incisors show an invagination of enamel on the grinding surface of the crown. The pit so formed is shallow, and comparatively soon wears down to a scar. I have not had an opportunity of examining European specimens with reference to this point, but the presence of the pit is clearly shown in Kowalewsky's figures (*Memoires de l'academie imper. de St. Petersbourg,* 7th ser. tome xx. pl. iii. figs. 55 and 57). Of fig. 57 (see fig. 2), Kowalewsky says, "Les incisives mitoyennes présentent déjà les puits en émail qui sont si charactéristiques pour les chevaux." This pit, seen in its earliest stages in Anchitherium, goes on increasing until it reaches its greatest development in the recent genus Equus. It is of interest to see that even in this small and comparatively unimportant detail we find a fresh confirmation of the accuracy of previously expressed views as to the series of equine ancestors. If these determinations are accurate, they must, of course, hold good down to the minutest details. Further investigation will undoubtedly bring more of these minor correspondences to light. W. B. SCOTT.

Geol. mus., Princeton, N.J., Dec. 16.

Equatorial currents in star and planetary atmospheres.

In the 'Astronomical notes' contained in the number of *Science* for Dec. 11, occurs a statement in regard to the circulation of the earth's atmosphere which seems to me to require qualification, and I therefore venture to call your attention to it. The passage in question reads as follows: "As to the earth, we know that the general drift of the lower atmospheric currents is eastward, rotating faster than the globe itself; but of the circulation high up above the clouds we knew absolutely nothing until the red sunsets following the Krakatoa outburst . . . indicated, by their successive appearances at different places, a probable upper equatorial current moving rapidly westward, i.e., rotating slower than the earth."

Now, it is well known that the eastward movement of the atmosphere is confined to the temperate zones, and is not observable in the polar or tropical regions. On the contrary, the most striking feature in the circulation of the atmospheres is the great equatorial wind-current which flows from *east to west* along the equator, and is felt beyond the tropics of Capricorn and Cancer. It is about 60° in width, and therefore covers one-half the earth's surface. It is also, as I believe, the most important factor in the whole system of oceanic and atmospheric circulation, since, by the friction of its movement over the ocean surface, it produces the great equatorial water-current which is the chief, though not the only, cause of all the great movements of oceanic waters. The

cause of this equatorial wind-belt is probably the lagging-back of the loosely cohering and adhering atmosphere over the equatorial region, which has a maximum motion of rotation from west to east of about a thousand miles an hour. The equatorial wind-current has a motion westward of from five to ten miles an hour, but this is only relative to the surface of the earth, since it has an absolute movement eastward with the earth of perhaps 990 to 995 miles an hour.

The lagging-back of the atmosphere over the tropical regions may be altogether due to its inertia, or it may be in part the effect of friction with that real but intangible medium which fills the interstellar spaces, — the luminiferous ether. Whatever the cause of the equatorial wind-current may be, its importance in the physics of the globe cannot be exaggerated. Among the other phenomena with which it may be credited are the red sunsets which are now generally believed — as stated by the editor of your astronomical column — to be due to the projection into this equatorial current of an immense volume of volcanic dust from Krakatoa, which has not only floated many times around the earth, but has been widely diffused north and south of the equator by the high upper currents of air that flow from the equator toward the poles, and constitute the other great factors in atmospheric circulation. Along the thermal equator the heated air is constantly rising, and is replaced by the cooler and denser air flowing along the surface from the north and south. This, coming from regions where the rotation of the earth is much less than at the equator, reaches the torrid zone with a strong relative motion toward the west, — going slower than the earth, — and giving us the south-east trades of the southern side of the equator, and the north-east of the northern. The constant upward tendency of the air along the heated zone would retard the descent of the dust, and favor its suspension in the heaped-up mass of air which flows northward and southward from the equator. This air, which has an absolute eastward movement with the earth of perhaps 990 miles per hour, soon reaches a zone where the earth's movement is less than this, and where, with reference to the surface, the movement is toward the north-east in the northern hemisphere, and south-east in the southern. This, as is known to many, but perhaps not to all, of your readers, gives us the general drift of the atmosphere over the United States.

By the northward and southward flow of the tropical and dust-bearing air, that dust may be diffused over most of the earth's surface before it settles.

J. S. NEWBERRY.

New York, Dec. 28.

Congenital deaf-mutism.

The chief requisite to racial experiments is isolation. A race of men is a breed, a stock, a strain that has been isolated long enough to fix by inheritance a number of characteri tics. This isolation may be either geographical or social. Where caste prevails and marriage is confined to groups, the characteristics of each group will be fixed and perpetuated. This is social isolation, and the result is in the nature of a race. At the time when there were fewer people on the earth, and when the allurements to commerce and the means of locomotion were not so numerous, the present races of the world were fixed.

Prof. A. Graham Bell has on several occasions lately called attention to the formation of a race of deaf-mutes by caste isolation and intermarriage. A very interesting example of reaching a race of deaf-mutes by geographical isolation has just come to my notice.

Lieut. H. T. Allen, U.S.A., lately engaged in the exploration of Alaska, writes me as follows: —

"On two tributaries of the Koukuk River, Konootenah and Nohoolchintnah, both emptying from the south, and about seventy-five miles between mouths, were two villages about twenty-five miles from the respective confluences, the upper village 66°.40′ north, 150°.50′ west. One village contained six males, the other five; and, of these eleven, four were deaf-mutes. There was a woman who could speak fairly intelligently to her people, but could not hear. There was also a boy who was a deaf-mute. The natives said that the mutes had never been able to speak or hear, and the sounds emitted had nothing in common with the articulations of their relatives. I can account for the foregoing facts only by continued intermarriage, which is necessitated by their isolation. Above the upper village there are no tribes on the Koukuk River, none between the Nohoolchintnah and Konootenah, and none for many miles below the latter river. The men from these villages trade at the station on the Yukon River, near the mouth of the Tananáh. They claim to be Kleekots, but can readily converse with the natives of the Yukon from St. Yukon to Nulato."

O. T. MASON.

The English sparrow.

Two years ago I published the fact in the *American naturalist* (September, 1883, p. 925), of the English sparrow having practically driven all the native birds out of the beautiful parks of New Orleans, when, even so long ago as that, this bird was to be found there in numbers. I distinctly recollect having seen them in Cheyenne, Wyoming, in 1877; so that I think this pest has spread more rapidly than some of the correspondents of *Science* are perhaps aware. Of course, the most important point at issue now, is to devise means for so reducing their numbers as to render them harmless in the future, or better still, if possible, to exterminate them entirely.

The methods suggested by Mr. Ralph S. Tarr (*Science*, No. 149) are excellent so far as they go; but I would suggest a far more efficient weapon than the shot-gun, for use in the city parks, recommended by him. I refer to the collecting cane now in use by many ornithologists in this country, with the seven-chambered pistol attachment. I have an excellent one by me now, belonging to the Smithsonian institution, and I will guarantee that I could kill 350 English sparrows with it in one day in New York City, and keep it up for every day in the year, or until their decreasing numbers reduced the average. It possesses several highly important recommendations over the shot-gun: it makes scarcely any noise; the ammunition is cheap; no danger is run of injuring persons in a crowded city; and it would attract far less attention. This weapon might be placed in the hands of those who proved themselves experts in its use, or any city police force. Other persons might also be licensed to use it, who were willing to practise exterminating the birds for a reward.

R. W. SHUFELDT.

Fort Wingate, N. Mex., Dec. 18.

SCIENCE.—SUPPLEMENT.

FRIDAY, JANUARY 1, 1886.

THE STUDY OF GEOMETRY.

WE have a pernicious habit in this country of supposing, that, because in a republic all men are born equal as to their rights, they are also born equal as to their abilities. We have a different theory in regard to horses: we know that a race-horse is altogether different from a dray-horse, and we give him a totally different kind of life from the beginning. We have no trouble in recognizing him: we simply inquire who were his ancestors, and our expectation as to his qualities is carefully based upon the answer to that question. It would, perhaps, be a good plan if the young of the human species were divided into two groups at an early age, — one large and one small; one composed of those of whom nothing more than plain living is expected, and the other composed of the race-horses, of those whose ancestors, or whose chance endowments, give reason to hope that they may give some aid to learning or to culture.

There is, at all events, no reason why all young people should be taught geometry in the same way. For most children, a form of reasoning so abstract is not only repulsive, but very nearly impossible of comprehension. A little may be done for them (or for their descendants) by giving them a small dose of geometry, made as plain and easy and direct as it can be made; but they do not need to know every thing that can be done with the straight line and circle. Life is short, and the whole content of geometry as known to Euclid is long. For most children in schools, a good specimen of the kind of reasoning, and a fair knowledge of the principal results, are all that is desirable. For such, a geometry like Wentworth's serves a very good purpose.

But it is a pity that the kind of geometry a person is taught should depend upon his geographical position near this or that kind of a school. Any one whose destiny is to do difficult thinking in after-life should have a different kind of early training: he should dwell long among the geometrical concepts, should become thoroughly imbued with the bare and rigid form of reasoning, and should have the results as familiar as his mother-tongue. It is a serious loss to him if he is made to run over the subject with uncouth haste. Students of this kind will find their natural guide in such a text-book as Newcomb's or Halsted's.[1] In neither is it the aim to give the most rapid and cursory system possible. Both are written from the stand-point of the modern idea that the geometry of this world is not the only possible geometry, and that it is mere matter of accident that two parallel lines do not approach each other, and that two straight lines do not enclose a space. Both have felt the influence of the syllabus of the English association for the improvement of geometrical teaching. The idea of figure is shorn of its material content, and limited to its bounding lines or surfaces. The sum of two right angles is not regarded as a purely imaginary idea with no reality corresponding to it, but the 'straight angle' is allowed to play its natural part. In Professor Newcomb's book, nis favorite idea is carried out of leading up to new and strange conceptions by very slow and gradual steps: Mr. Halsted's is intended for boys[2] of much more highly developed minds. There are no concessions to youthful weakness. It is also intended for boys of well-developed taste in the art of book-making. It presents a splendor of paper and of margin which is far removed from the republican simplicity of our ancestors.

The ancients believed that the geometrical concepts came down from heaven, but that the chief end of geometry was to measure the earth. We admit now that the concepts are, in the first instance, of the earth and earthy; but we have given an enormous development to the geometry of pure position, and have made it as remote from all possibility of application as the theory of numbers itself. It is in consonance with this development that in both these books measurement is given somewhat the position of an appendix to the subject, instead of being made to appear as the end towards which all the propositions lead up.

Mr. Halsted does an excellent thing in giving an introductory chapter on logic. When pure reasoning is about to become the student's daily occupation for many months, it is a pity not to give him a general view of the processes involved at the start. It

[1] *The elements of geometry.* By GEORGE BRUCE HALSTED. New York, *Wiley*, 1885. 8°.

[2] As a synonyme for 'student of geometry,' one should, however, say *girl* with the understanding that boys are to be included. Geometry is chiefly studied in the high schools, and the high-school graduates number three girls to every boy. If geometry is as good a specific against bad reasoning as is commonly supposed, logicalness will soon become a feminine instead of a masculine characteristic.

is very curious to find a compendium of logic with the syllogism left out. Hamlet is even less necessary to his play than the syllogism to logic. It is true, however, that the syllogism is an easy matter compared with inversion and contra-position. There is hardly a boy who is not greatly surprised to find that when he has proved that an isosceles triangle has two equal angles, it still remains to be proved that a triangle having two equal angles is isosceles. As De Morgan has pointed out, Euclid himself was apparently not aware that it follows every time from *A implies B* that *non-B implies non-A*.

In regard to 'his rule of inversion,' when three or more propositions are involved, Mr. Halsted has fallen into a slight inaccuracy. In the first place, if the term 'contradictory' is to be applied to three terms at all, it should be used in the same sense as when applied to two terms; the three terms should together cover the whole field, and they should not overlap. The word is a bad one for this purpose, however, and it is just as well to keep the two properties — that of being exhaustive and that of being incompatible — distinct.

In the second place, there is a redundancy in the rule as given by Mr. Halsted. From the three propositions,[1]

X implies x,
Y implies y,
Z implies z,

it may be inferred that

x implies X,
y implies Y,
z implies Z,

provided that *the subjects cover the whole field, and the predicates are incompatible.* It is not necessary that the subjects should be known to be incompatible, though it follows from the premises given that they are so, but also that the predicates are exhaustive. From the first two we have

X Y implies x y;

and, since there is no x y, there cannot be any X Y either.

It is very well worth while to have formulated the reasoning involved, instead of going through all the separate steps every time there is occasion for it, as the usual books on geometry do.

The conclusion does not follow if it is given that the subjects are incompatible, and that the predicates together fill the universe. The nature of the argument is most clearly seen in space. Lange believes that the logical laws of thought are derived from space-conceptions. Suppose there is a table painted in various colors, but so that

the red is all in the violet,
and the yellow is all in the blue,
the orange is all in the green;

[1] The letters stand for either terms or propositions.

and suppose, also, that the red, the yellow, and the orange together cover the whole table, and that the violet, the blue, and the green do not overlap: it follows that

red = violet,
yellow = blue,
orange = green.

To show how a somewhat complicated argument can be simplified by having this type of reasoning at command, we add a real illustration from algebra. In Descartes' method of solution of the biquadratic equation, the following relations are seen to hold between its roots and those of the auxiliary cubic: —

Roots of the biquadratic.		*Roots of the cubic.*
All real	*implies*	All real and positive.
Two real (unequal)	*implies*	One positive, two imaginary.
Two real (equal)	*implies*	One positive, two equal negative.
All imaginary	*implies*	One positive, two unequal negative.

But the division on the left is exhaustive, and the classes on the right are mutually exclusive: hence, by a purely logical *tour de force*, these propositions can all be inverted, and the desired inferences *from* the roots of the cubic *to* the roots of the biquadratic can be obtained at once.

Mr. Halsted's reviewers have pointed out before that he is deficient in a certain natural and becoming modesty. 'Two formative years' of his life is too high-sounding a phrase to be applied to any but a very great mathematician, like Professor Cayley, for instance.

CEREBRAL EXCITABILITY AFTER DEATH.

THE problems of brain physiology are so complex, and our means of studying them, especially in the human subject, so insufficient, that it is not to be wondered at if rather out-of-the-way and venturesome experiments are sometimes undertaken by the anxious physiologist; as, witness the actual stimulation of the exposed brain in a patient whose death seemed certain. Such an experiment is not apt to be repeated; and a few French physicians have now wisely set to work to study the results of stimulating the cerebrum, exciting the sense-organs, and subjecting the whole body to a vigorous examination in the case of criminals who have suffered death by decapitation.[1] Such investigations are not new; but the results have been, as a rule, either entirely negative, or brought out only a few rather obvious facts. In the experiments about to be described, the methods

[1] *Revue scientifique*, NOV. 28. By J. V. LABORDE.

of experimentation have been much improved, mainly by keeping up the spark of life, artificially, for a much longer time than was ever before accomplished.

A dog was prepared in such a way that a transfusion of blood from its carotid artery to one of the carotids of the head of the decapitated criminal could be promptly made, and thus a supply of living blood be made to flow through the lifeless head, and thereby preserve the excitability of the nervous apparatus. Into the other carotid (the right) of the head defibrinated blood at a suitable temperature could be injected. The head was received seven minutes after decapitation. The difficulty of finding the carotids in the soft tissues, which had become sadly disfigured by the decapitation, caused a loss of ten minutes. A small opening in the cranium was then made, so as to insert a pair of electrodes on the frontal parietal region of the left side, — the presumable motor centre for the facial muscles. At about twenty minutes after decapitation the double transfusion of blood was begun. The result was striking : a bright color returned to the face, which also assumed a natural expression. The effect was most marked on the left side, which received its blood-supply direct from the dog. The electrodes were inserted, but no result followed. Thinking this might be due to a stimulation of the wrong spot, they made another opening in the skull, and again stimulated the brain. This was followed by a regular and marked contraction of the muscles of the *opposite* side of the face, involving the orbicular and the superciliary muscles, together with a movement of the lower jaw, causing a strong chattering of the teeth. This effect could be repeated at will up to the 40th minute after decapitation, and, by increasing the current used in stimulation, to the 49th minute. After this no movement followed the application of the electrodes, although the facial muscles could be made to contract by direct stimulation of the muscles. The failure of the first stimulation was afterwards shown to be due to the unusual length of the head, thus causing an error of a few millimetres in the localization. At first the pupil could be made to dilate and contract by the approach or withdrawal of a strong light, — a fact frequently observed in previous cases. The peculiarities of the case are the great length of time for which the excitability remained, and the means employed for preserving this excitability, namely, the transfusion of living blood.

An opportunity of verifying these results presented itself in a subsequent case, but the results of cortical stimulation were negative. The explanation was offered, that the individual had furiously resisted the attempts of the officers to put his body in position for decapitation, and that the resultant neuro-muscular excitability prevented the orderly action of the electrical stimulation. However, a few new results were obtained. In the first place, the patellar or knee reflex, obtained by striking the tendon, was distinctly observed on the body. The contraction was perfectly normal. Another remarkable result was this : the cephalic end of the medulla was stimulated in hopes of exciting the nucleus of the hypoglossal nerve. The attempt was successful, and movements of the tongue such as follow direct stimulation of the nerve were distinctly observed.

Physiologists have not been very sanguine of results from this method of research ; but it seems that its importance has been rather underestimated. It will never be available for original investigations ; but it will serve as a means of verifying results otherwise obtained, and makes the inference from the facts with regard to animals to similar conditions in man more reliable.

PARASITISM AMONG MARINE ANIMALS.

IT is a curious fact that nearly all well-defended marine animals are either brilliantly colored or otherwise attractive, as in the case of the sea-anemone, jelly-fish, and tropical shells and crabs. Those with little or no defence are generally inconspicuous, or resemble surrounding objects. This may be explained by supposing that by being inconspicuous they easily escape the notice of their enemies. Brilliant, well-defended animals have little fear of enemies, and by their bright colors attract curious animals within reach of their deadly powers.

Many a fish in the sea instinctively avoids the deadly power hidden behind the brilliantly phosphorescent jelly-fishes. This protective light has saved the jelly-fish much trouble, and is a great aid to it in its struggle for existence among the multitudes of surface animals. Through some curious freak in evolution, an entirely inoffensive cluster of animals, devoid of any protective power, has gained the use of this phosphorescent light, and, by imitating the dangerous jelly-fishes in this respect, sails about the surface, inspiring terror among surface animals that could easily devour them. This cluster of animals is Pyrosoma. In the clusters of floating seaweed in the Gulf Stream there are vast numbers of tiny fishes attired in the color of the floating weed, and that certainly gain protection thereby.

The lump-fish has a sucker on its body by which it can attach itself to some fish of a similar

color, and go freely about, entirely free from danger. This is, no doubt, one way in which parasitism originated. At first an animal attached itself, for protection, to another having the same color; the next step was to burrow into the animal, and extract juices. There is a very curious fish that burrows in the side of another, leaving only a small opening out of which it can project its head and take food. Beyond this it does no harm to the fish. A curious case of parasitism is noticed in Penella, a copepod which burrows into the side of a sword-fish, and has upon its external stem a number of a peculiar species of barnacle, which in its turn has become parasitic.

The sting of the jelly-fish is deadly to nearly every animal of limited size; yet there is a small fish that habitually lives beneath the bell of the jelly-fish, in the midst of flying lasso-cells, without being injured. It manages to pick up a very good living from the crumbs left by the jelly-fish. What benefit it is to its host is hard to understand; but it is usually true, in such cases, that some service is returned. The habit of eating at the same table, or commensalism, is seen in many cases, that of the oyster-crab being a very good example. This crab lives within the oyster without offering harm, although it could easily destroy the oyster; but it is satisfied with what it gets, and leaves its friend alone. That such deadly powers as those possessed by jelly-fishes should have no effect, strange though it may seem, is hardly more wonderful than the power of resisting digestive fluids. In the stomach of a deep-sea sea-anemone a brightly-colored annelid is often found, in the digestive cavity. Whenever the anemone catches a fish, the annelid shares the meal without any injury to the anemone. Unlike intestinal worms, they are never numerous enough to be of any injury to their host.

This habit of one animal being dependent upon another for its existence receives a curious development in the case of deep-sea hermit-crabs and the sandy sea-anemones, of which Epizoanthus is an example. After the free-swimming stage, the anemone settles down upon the back of a shell inhabited by a hermit-crab, and begins to grow around the shell until it has entirely surrounded it, leaving only the entrance clear. The shell is eventually absorbed; and as the hermit grows, the anemone grows to accommodate him, so that he does not have to seek after a new shell. Thus the hermit is furnished with an accommodating, comfortable, and transportable house; but, in return, the hermit transports the sea-anemone from place to place, and keeps it upright. This is a curious case of division of labor among the lower animals.

There is a wide field for the study of the effects of hereditary instinct and evolutionary changes, as exhibited in the cases mentioned. Indeed, it would seem as if the best field for the evolutionist lay among the most degenerate types of an order, viz., parasites; for in their embryonic changes they pass through the higher stages of the past on their way to their present degeneration.

RALPH S. TARR.

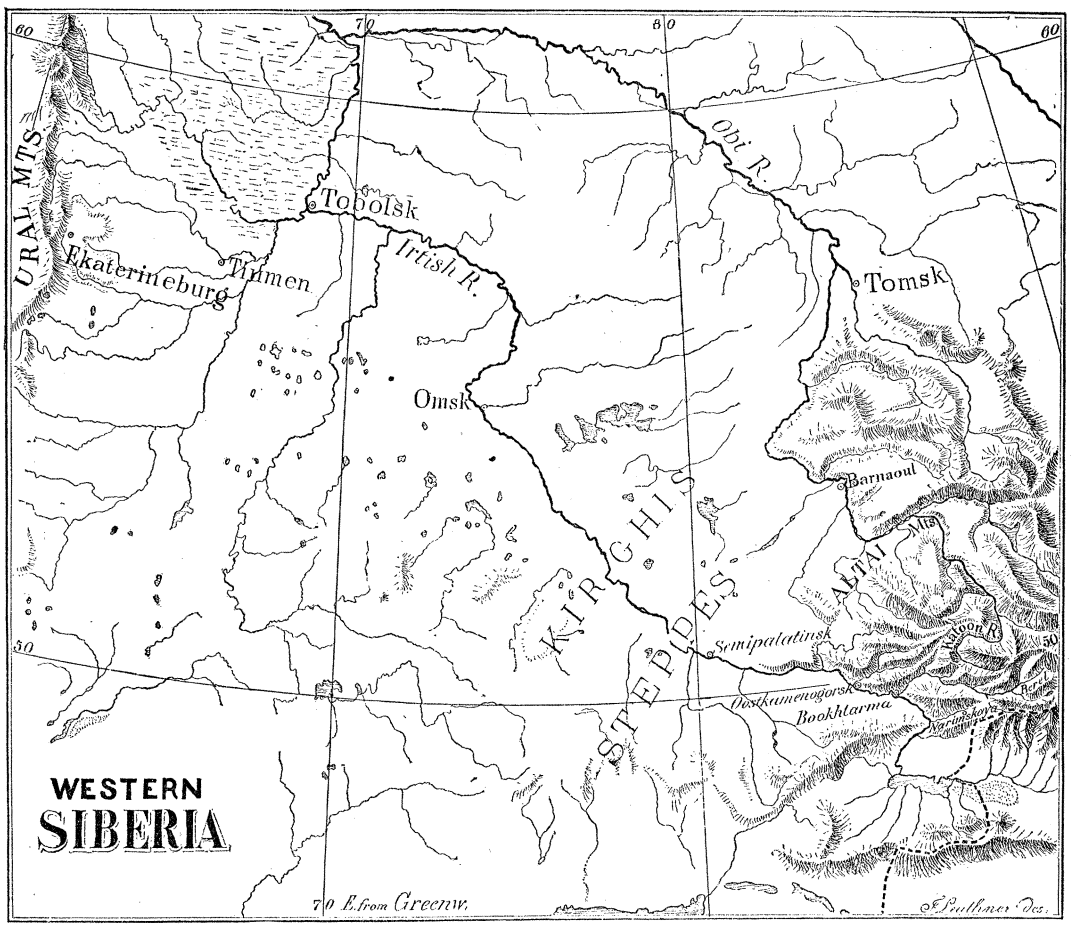
A TRIP TO THE ALTAI MOUNTAINS.

WE left Semipalatinsk on Saturday, July 18, for a trip of about 1,000 versts, or 700 miles, into the wild mountainous region of the Altai. If you will draw a line on the map from the city of Tomsk, in a south by east direction, 600 miles or more, until it strikes the Chinese frontier, you will reach the region which I hoped to explore. The German travellers, Finsch and Brehm, went to the edge of it in 1876, but the high peaks lying farther to the eastward had never been seen by any foreigner, and had been visited by very few Russians. As far as the Cossack outpost known as the Altai Station, there was a post-road. Beyond that point I expected to go on horseback. The road runs from Semipalatinsk up the valley of the Irtish as far as the town of Oostkamenogorsk, and then turns away into the mountains, descending again to the Irtish at the station of Bookhtarma, and finally leaving it altogether at Bolshe-Narimskaya.

For 200 versts after leaving Semipalatinsk, the Irtish is bordered by a great rolling steppe of dry, yellowish grass. Here and there, where this steppe is irrigated by small streams running into the Irtish, it supports a rich vegetation; the little valleys being filled with wild roses, hollyhocks, golden rod, wild currant and gooseberry bushes, and splendid spikes, five or six feet high, of dark ultramarine flowers like larkspur; but generally the steppe is barren and sun-scorched. At Oost-Kamenogorsk and Oolbinsk I made the acquaintance of two very interesting colonies of political exiles, who received me with great friendliness and cordiality.

The farther we went up the Irtish, the hotter became the weather, and the more barren the steppe, until it was easy to imagine one's self in an Arabian or a North African desert. The thermometer ranged day after day from 90° to 103° F. in the shade; the atmosphere was suffocating; every leaf and every blade of grass, as far as the eye could reach, had been absolutely burned dead by the fierce sunshine; bleaching bones of perished horses lay here and there by the roadside; great whirling columns of sand, 100 to 150 feet in height, swept slowly and majestically across the sun-

scorched plain; and we could trace the progress of a single Kirghis horseman five miles away by the cloud of dust which his horse's hoofs raised from the steppe. I suffered constantly and intensely from the heat and thirst, and had to protect myself from the fierce sunshine by swathing my body in four thicknesses of heavy blanket, and putting a big down pillow over my legs. You can perhaps imagine what that sunshine was, when I tell you that I could not hold my bare hand in it without pain, and that wrapping my body in four thicknesses of heavy blanketing gave me at once a sensation of coolness. Tolerably familiar as I was with Siberia, I little thought, when I left Tiumen, that I should find in it a North African desert with whirling sand-columns, and sunshine from which I should have to protect myself with blankets. I almost laughed at a Russian officer in Omsk who told me that the heat in the valley of the Irtish was often so intense as to cause nausea and fainting (sunstroke?), and who advised me not to travel between eleven o'clock in the morning and four in the afternoon, when the day was cloudless and hot. The idea of having a sunstroke in Siberia, and the suggestion not to travel in the middle of the day, seemed to me so preposterous that I could not restrain a smile of half incredulous amusement. Governor Tseklinski, the military governor at Semipalatinsk, subsequently told me that he had seen the thermometer stand at 130° F. in the valley of the Irtish, with a sandstorm from the south, and that breathing during the prevalence of this simoom-like wind was attended with an almost insupportable sense of suffocation. We saw nothing so bad as that; but at the station of Voroninskaya, in the middle of the arid desert of the upper Irtish, we were overtaken by a furious sand-storm from the south-west with a temperature of 90° F. in the shade in our tarantass. The sand and fine hot dust were car-



ried to a height of a hundred feet, and drifted past us in dense, suffocating clouds, hiding every thing from sight, and making it almost impossible to see or breathe. Although we were riding with the storm, and not against it, I literally gasped for breath for more than two hours ; and, when we reached the station of Cherem-shanka, it would have been hard to tell, from an inspection of our faces, whether we were Kirghis or Americans, — black men or white. Such wind, with such suffocating heat and blinding dust, I never in my life experienced before.

At the station at Mala-Krasnoyarskaya we left the Irtish to the right, and saw it no more. Late that afternoon we reached the first outlying ridges of the great mountain-chain of the Altai, and began the long gradual climb to the Cossack outpost known as the Altai Station. Before dark on the following day we were riding through cool, elevated alpine meadows, where the fresh, green grass was intermingled with blue-bells, fragrant spirea, gentians, and delicate fringed pinks, and where the mountain-tops over our heads were white a thousand feet down with freshly fallen snow. The change from the torrid African desert of the Irtish to this superb Siberian Switzerland was so sudden and so extraordinary as to be almost bewildering. At any time, and under any circumstances, the scenery would have seemed to me beautiful, but, after 2,000 versts of unbroken steppe, it made upon me a most profound impression.

We reached the Altai Station about six o'clock in the cool of a beautiful calm midsummer afternoon, and I shall never forget the enthusiastic delight which I felt as I rode up out of a wooded valley, fragrant with wild flowers, past a picturesque cluster of colored Kirghis tents, across two hundred yards of smooth, elevated meadow, into the little settlement of log-houses, and then looked about me at the mountains. Never, I thought, had I seen an alpine picture which could for a moment stand comparison with it. It was unsurpassed in my experience, and, it seemed to me, unsurpassable. I have seen since then the higher and grander peaks farther to the eastward, known as the Bailkee, where the Katoon River springs fully grown out from under enormous glaciers, and rushes away in a furious torrent to the Obi, through the wildest scenery in northern Asia ; but I still think, that for varied beauty, picturesqueness, and effectiveness, the mountain landscape which opens before the traveller's eyes as he ascends out of the valley to the Altai Station is unequalled.

The station itself is a mere Cossack outpost of seventy or eighty log-houses standing in rows, with wide clean streets between, and with a quaint wooden church at one end. In front of every house in the settlement is a little enclosure, or front yard, filled with young birches, silver-leaf aspens, and flowering shrubs ; and through all of these yards, down each side of every street, runs a tinkling, gurgling stream of clear cold water from the melting snows on the mountains. The whole village, therefore, go where you will, is filled with the murmur of falling water ; and how pleasant that sound is, you must travel for a month in the parched, sun-scorched, dust-smothered valley of the Irtish to fully understand.

We remained at the Altai Station three or four days, making excursions into the neighboring mountains, visiting and photographing the Kirghis, and collecting information with regard to the region lying farther east which we proposed to explore. On Monday, July 27, we started for a journey of about 300 versts to the Katoonski Alps, or 'Bailkee,'— the highest peaks of the Russian Altai. Our trip occupied ten days, during three of which we lay in camp storm-bound in the Rakhmanofski valley, nearly 7,000 feet above the sea. The last sixty versts of our journey were made with great difficulty and some peril, our route lying across tremendous mountain-ridges, and deep valleys with almost precipitous sides, into which we descended by following the course of foaming mountain-torrents, or clambering down ancient glacier moraines, over great masses of loose broken rocks, through swamps, jungles of bushes and fallen trees, and down slopes so steep that it was almost impossible to throw one's body far enough back to keep one's balance in the saddle ; while one's horse was half the time sliding on all four feet, and dislodging stones, which rolled and bounded for half a mile downward until they were dashed to pieces over tremendous precipices. I was not inexperienced in mountain travel, having ridden on horseback the whole length of the peninsula of Kamchatka, and crossed three times the great range of the Caucasus ; but I must confess, that during our descents into the valleys of Rakhmanofski, the Black Berel, the White Berel, and the Katoon, my heart was in my mouth for two hours at a time. On any but Kirghis horses such descents would have been utterly impossible. My horse fell with me once, but I was not hurt. The region through which we passed is a primeval wilderness full of wild game. We saw marals or Siberian elks, wolves, wild sheep, abundant fresh traces of bears, chased wild goats on horseback, and could have shot hundreds of partridges, grouse, ducks, geese, herons, and eagles. The flora of the lower mountain valleys was extremely rich, varied, and luxuriant, comprising beautiful

wild pansies, — purple, yellow, cream-white, and variegated, — fringed pinks, spirea, blue gentians, wild hollyhocks, daisies, forget-me-nots, alpine roses, purple Altai lilies, and scores of flowers that I had never before seen, many of them extremely brilliant, large, and showy. Of plants and fruits, — which with us are domesticated, but which in the Altai grow wild, — I noticed rhubarb, celery, currants (red and black), gooseberries, raspberries, strawberries and blackberries, wild cherries, crab-apples, and wild apricots or peaches. Most of the berries were ripe or nearly so; and the wild currants, in particular, were as large and abundant as in an American garden. The scenery was extremely wild and grand, surpassing at times any thing that I saw in the Caucasus.

On Saturday, Aug. 1, we reached the foot of the last great ridge or watershed which separated us from the main chain of the Katoonski Alps. Sunday morning we climbed about 2,000 feet to the summit of the last ridge, and looked over into the wild valley of the Katoon, out of which rise the 'Katoonski pillars,' the highest peaks of the Russian Altai. I was prepared for something grand in the way of scenery, because I had already seen those peaks two or three times, at distances varying from 25 to 30 miles; but the near view from the heights above the Katoon so far surpassed all my anticipations, that I was simply overawed. It was not beautiful, it was not picturesque: it was overwhelming and stupendous.

The deep, narrow valley or gorge of the Katoon, which lay almost under our feet, was somewhere between 2,000 and 3,000 feet deep. On the other side of it rose far above our heads the wild, mighty chain of the Katoonski Alps, culminating just opposite us in two tremendous snowy peaks, whose height I estimated at 15,000 feet. Colonel Maiyfski, the governor of the district, has since told me that they are believed to be not less than 18,000 feet in height. They were white from base to summit, except where the snow was broken by great black precipices, or pierced by sharp, rocky spines and crags. Down the sides of these peaks, from vast fields of *névé* above, fell enormous glaciers, the largest of them descending from the high saddle between the twin summits in a continuous ice-fall of at least 4,000 feet. The glacier on the extreme right had an almost perpendicular ice-fall of twelve or fifteen hundred feet, and the glacier on the extreme left gave birth to a torrent which tumbled about 800 feet with a hoarse roar into the deep, narrow gorge. The latter glacier was longitudinally subdivided by three moraines, which looked, from our point of view, like long, narrow-shaped dumps of furnace-slag or fine coal-dust, but which, when I afterward climbed up on them, I found to be composed of black rocks from the size of my head to the size of a house, extending four or five miles, with a width of 300 feet, and a height of from 25 to 75 feet above the general level of the glacier. The extreme summits of the two highest peaks were more than half the time hidden in clouds; but that rather added to, than detracted from, the wild grandeur of the scene, by giving mystery to the origin of the enormous glaciers, which at such times seemed to the imagination to be tumbling down from unknown heights in the sky through masses of rolling vapor. All the time there came up to us from the depths of the gorge the hoarse roar of the waterfall, which seemed now and then to be almost lost in the deeper thunder which came from the great glaciers, as masses of ice gave way and settled into new positions in the ice-falls. This thundering of the glaciers continues for nearly a minute at a time, varying in intensity, and resembling occasionally the sound of a distant but heavy and rapid cannonade. No movement of the ice in the falls was perceptible to the eyes from the point at which we stood; but the sullen, rumbling thunder was evidence enough of the mighty force of the agencies which were at work before us.

After looking at the mountains for half an hour, we turned our attention to the valley of the Katoon beneath us, with a view to ascertaining whether it would be possible to get down into it, and reach the foot of the main glacier which gives birth to the Katoon River. Although the descent did look both difficult and dangerous, I was by no means satisfied that it was utterly impracticable. While we were discussing the question, our guide was making a bold and practical attempt to solve it. We could no longer see him from where we stood; but every now and then a stone or small bowlder, dislodged by his horse's feet, would leap into sight three or four hundred feet below us, and go crashing down the mountain-side, clearing two hundred feet at every bound, and finally dashing itself to pieces against the rocks at the bottom with a noise like a distant rattling discharge of musketry. Our guide was evidently making progress. In a few moments he came into sight on a bold rocky buttress about six hundred feet below us, and shouted cheerfully, 'Come on! You could get down here with a telega' (a Russian peasant's cart). Inasmuch as one could hardly look down there without getting dizzy, this was a rather hyperbolical statement of the possibilities of the case.

We finally reached a very steep but grassy slope, like the side of a Titanic embankment, down which we zigzagged with great discomfort, but without much actual danger, to the bottom of the Katoon

valley. As we rode up the gorge toward the great peaks, and finally, leaving our horses, climbed up on the principal glacier, I saw how greatly, from our previous elevated position, I had underestimated distances, heights, and magnitudes. The Katoon River, which from above had looked like a narrow, dirty-white ribbon, that a child could step across, proved to be a torrent thirty or forty feet wide, with a current almost deep and strong enough to sweep away a horse and rider. The main glacier, which I had taken to be about three hundred feet wide, proved to have a width of more than half a mile; and its central moraine, which had looked to me like a strip of black sand thirty feet wide, piled up in form to a height of six or seven feet, like a long furnace dump, proved to be an enormous mass of gigantic rocks three to four miles long, and three hundred to four hundred feet wide, piled up on the glacier in places to heights of seventy-five and eighty feet. In short, it was a tremendous glacier, and yet it was only one of eleven which I counted from the summit of the ridge between the Black and the White Berel. Seven glaciers descend from the two main peaks alone.

We spent all the remainder of the day in sketching, taking photographs, and climbing about the valley and the glaciers, and late in the afternoon returned to our camp in the valley of the White Berel.

Monday we made another excursion to the crest of the Katoonski ridge, and succeeded in getting a good photograph of the two great peaks without a cloud.

We returned to the Altai Station, Wednesday, Aug. 5, and two days later started back for Oost-Kamenogorsk. We were overtaken by a storm in the mountains between Bookhtarma and Alexandrofskaya; lost our way; our tarantass capsized into a hole about nine o'clock at night in the darkness; and we lay there until morning in a cold rain, without shelter, food, or fire. Shortly after daybreak help arrived from the nearest settlement; but it took eight horses and three drivers, two of the latter mounted, to get our tarantass to the next station. GEO. KENNAN.

CURRENTS OF THE NORTH SEA.

THE 79th supplement to *Petermann's mittheilungen* is by Prof. H. Mohn, director of the meteorological institute in Christiania, on 'Die strömungen des europäischen Nordmeeres.' The area thus designated lies between Norway, Novaya Zemlia, Greenland, Iceland, and Scotland, and has been examined by several exploring vessels, especially by Norwegians; so that tolerably full data as to depth, temperature, and salinity, have been determined from surface to bottom. On this basis, Professor Mohn has attempted a new style of investigation of its currents, fed on the south by the warm, dense waters of the North Atlantic; on the north, by the cold, fresher waters from the polar seas. His method is much like that which has been successfully applied to the study of atmospheric currents, and it has led him to very interesting conclusions. First, the density is examined, and the results graphically exhibited on ten sections. Next follow a series of detailed investigations, summarized in six maps, showing, 1°, surface isotherms; 2°, contour lines as determined by hydrostatic equilibrium, the North Sea thus appearing five centimetres higher than the ocean east of Iceland; 3°, the atmospheric pressure for the year, prevailingly low from Iceland towards the North Cape; 4°, the deformation of the surface of wind-formed currents by the deflective force arising from the earth's rotation, which depresses the central area about fifteen decimetres below the marginal; 5°, the same, due to both gravitative and wind currents; and, 6°, the summation of all persistent deforming causes. The currents themselves, as thus deduced, are shown in a larger map; their correspondence with what might be inferred from the isotherms establishes the correctness of the work. Finally, the pressure, temperature, and currents at depths of 500, 1,000, and 1,500 fathoms, are discussed and graphically illustrated in three pairs of maps. Taking this with an earlier monograph (supplement No. 63) by the same author, we have a very full description of the average physical conditions of these northern waters. The methods employed by Mohn may some day be well applied to the American Mediterranean from the Windward Islands around to the Bahamas.

W. M. DAVIS.

THE venerable Professor Vilanova secured the indorsement of the International geological congress, at its last session, to the project of a polyglot dictionary of definitions and technical terms. He himself cannot do more than supply the Spanish-French part of such a work ('Ensayo de diccionario geográfico-geológico,' por D. Juan Vilanova), but he hopes others will take up and supplement his work, until a cyclopaedia of the sciences is produced in which any man can readily find exact statements of the facts in his own language, and their equivalents in all other languages. It is an important work, and the congress and all geologists will doubtless help him to the extent of their power.